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FOSSIL REMAINS OF BIRDS

COLLECTED IN

NEW ZEALAND

BY

WALTER MANTELL, Esq.,

OF WELLINGTON.

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VICE-PRESIDENT OF THE GEOLOGICAL SOCIETY, ETC

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VARIOUS PARTS OF NEW ZEALAND

BY MR. WALTER MANTELL, OF WELLINGTON.

By GIDEON ALGERNON MANTELL, Esq., LL.D., F.R.S.,

VICE-PRESIDENT OF THE GEOLOGICAL SOCIETY.

It is not a little remarkable that one of the most interesting palæontological discoveries of our times, namely the former existence of a race of colossal Ostrich-like birds in the islands of New Zealand, though made in a British colony, and announced to the scientific world by an eminent British physiologist, has not hitherto been brought under the immediate notice of the Geological Society of London. I therefore consider myself particularly fortunate in having the opportunity, through the researches of my eldest son, Mr. Walter Mantell, of submitting for the examination of the Fellows of this Society, perhaps the most extraordinary collection of the fossil remains of struthious birds that has ever been transmitted to Europe, and which contains the crania and mandibles, egg-shells, and bones, of several genera and species, most, if not all of which have probably long been extinct.

The first relic of this kind was made known to European naturalists by Professor Owen, in 1839. It consisted of the shaft of a femur or thigh-bone, but a few inches long, and with both its extremities wanting; and this fragment so much resembled in its general appearance the marrow-bone of an ox, as actually to have been regarded as such by more than one eminent naturalist of this metropolis. And if I were required to select from the numerous and important inductions of palæontology, the one which of all others presents the most striking and triumphant instance of the sagacious application of the principles of the correlation of organic structure enunciated by the illustrious Cuvier,—the one that may be regarded as the

experimentum crucis of the Cuvierian philosophy,—I would unhesitatingly adduce the interpretation of this fragment of bone. I know not among all the marvels which palæontology has revealed to us, a more brilliant example of successful philosophical induction—the felicitous prediction of genius enlightened by profound scientific knowledge.

The specimen was put into Professor Owen's hands for examination, with the statement "that it was found in New Zealand, where the natives have a tradition that it belonged to a bird of the Eagle kind which had become extinct, and to which they gave the name of Movie;" and from this mere fragment, and with this meagre history, the Hunterian professor arrived at the conclusion, "that there existed, and perhaps still exists in those distant islands, a race of struthious birds of larger and more colossal stature than the Ostrich or any other known species." This inference was based on the peculiar character of the cancellated structure of the bone, which differs from that of mammalia, and most closely resembles that of the Ostrich. And so confident was Professor Owen of the soundness of his inductions, that he boldly added, "so far as my skill in interpreting an osseous fragment may be credited, I am willing to risk the reputation for it on this statement;" and he further remarks, "The discovery of a relic of a large struthious bird in New Zealand is one of peculiar interest, on account of the remarkable character of the existing fauna of those islands, which still includes one of the most extraordinary and anomalous genera of the struthious order, the *Apteryx*; and because of the close analogy which the event indicated by the present relic offers to the extinction of the Dodo of the island of the Mauritius. So far as a judgement can be formed of a single fragment, it seems probable that the colossal bird of New Zealand, if it prove to be extinct, presented proportions more nearly resembling those of the Dodo, than of any of the existing *Struthionidæ*." In 1843 the correctness of these views was confirmed in every essential particular by a large collection of bones obtained by the Rev. W. Williams and transmitted to the Dean of Westminster; and still further corroborated by another interesting series brought to England in 1846 by Percy Earl, Esq.; and by the collection which forms the immediate subject of this communication.

My eldest son, who went to New Zealand in 1839, and settled at Wellington, in one of his earliest letters to me after his arrival, mentioned that a tradition was prevalent among the *Maories* or natives, that gigantic birds, taller than a man, were formerly abundant throughout the islands; and that some of the oldest of the natives averred that they had seen such birds; and that although much reduced in numbers, some of the race still existed in the unfrequented and inaccessible parts of the country. They called these birds *Moa*, and affirmed in proof of their statement, that enormous bones were occasionally met with in the mud and silt of the streams and rivers; but my son was unable to obtain any of the bones in question.

Upon learning from me of the discovery of the bone described by Professor Owen, he endeavoured to obtain further information on

this interesting subject ; but until 1846, when he resigned an official situation, he was unable to follow up his inquiries with success. In the meanwhile the collections of the Rev. W. Williams, Mr. Percy Earl, and of other gentlemen, had furnished the materials from which Professor Owen drew up his two celebrated memoirs on the *Dinornis*, an extinct genus of tridactyle Struthious Birds, which were published in the third volume of the Transactions of the Zoological Society.

In 1846, and the commencement of 1847, my son explored every known locality of these relics in the North Island within his reach, and went into the interior of the country and located with the natives, for the purpose of collecting specimens of the then unknown parts of the skeletons, and of ascertaining whether any of these gigantic birds were still in existence ; resolving, if there appeared to be even a remote chance of this being the case, to penetrate farther into the interior and obtain one alive. The information he gathered from the natives offered no encouragement to follow up the pursuit, at least in that part of the country, but tended to confirm the idea that the gigantic struthious birds had become extinct, the last of the race having, like the Dodo, been destroyed by man within a comparatively recent period ; and that if any of the species whose bones are found in a fossil state are still living, it is probable they will be those of small size, and related to the *Apteryx*, the living diminutive representative of the colossal bipeds that once trod the soil of New Zealand.

With these introductory remarks, which appeared to me necessary to place the history of the discovery in a clear point of view, I propose, first, to notice the geological conditions under which these fossil bones appear to have been accumulated ; secondly, to describe in general terms the most remarkable features of the collection before us ; and lastly, to offer some observations on the bearing of these facts on that difficult problem, that "*mystery of mysteries*," as it has been emphatically termed by Sir John Herschel, the appearance and extinction of certain types of organic beings on the surface of the globe.

I. *Geological position of the deposits in which the bones occur.*—In attempting to arrive at a correct knowledge of the relative geological age of the deposit in which the bones sent to this country were found imbedded, I have experienced considerable difficulty, in consequence of the unsettled state of the orthography of the various localities, and also from the indefinite manner in which the collectors describe the places whence they obtained the specimens. Unfortunately the letter from my son containing details of this nature, and to which in his subsequent correspondence he refers me for the necessary information, has not reached me. I endeavoured to mark on a map of New Zealand all the localities whence bones had been obtained, but several places mentioned by the collectors are not inserted. I will therefore briefly state the circumstances under which the bones are described as occurring by the gentlemen who have transmitted them to this country.

The Rev. W. Williams, in his letter of Feb. 1842, states, "that none of the bones have been found on dry land, but are all of them from the beds and banks of freshwater rivers, buried only a little distance in the mud. The largest number are from a small stream in Poverty Bay, the river Wairoa, and from many inconsiderable streams, all of which are in immediate connection with hills of some altitude."

A mutilated cranium, described by Professor Owen*, was obtained by Mr. Williams from the bed of a mountain-stream descending to the coast at Poverty Bay in the North Island. Another, sent over by W. Swainson, Esq.†, is from the vicinity of the Bay of Islands. "Both of these have a ferruginous tint and great weight, arising from an infiltration of peroxide of iron; but the cancelli of the bone contain only a little of the dry powdery alluvium of the stream into which the specimens have been washed‡."

The Rev. W. Colenso, who in 1841-1842 accompanied Mr. Williams in search of the Moa, has given a very interesting account of the circumstances under which the bones were procured in the bed of the Waiapu river by the natives, by whom they were sought for to make fish-hooks §. He states, that travelling southward from Poverty Bay, he came within sight of *Wakapunake*, the mountain celebrated among the natives as the residence of the surviving Moas; but no bones were obtained from thence. "The Maories affirmed that Moas lived there, but admitted that no one had seen any of these gigantic bipeds. The Moa's bones were only to be found after the floods occasioned by heavy rains, when they were to be seen after the waters subsided, washed up on the banks of gravel and mud on the river-side; but none were then to be procured. I offered large rewards for any that should be met with, and directed them to be taken to Mr. Williams in Poverty Bay. At the base of the mountain is the river *Wangaruo*, which is a branch of the Wairoa, which runs into Hawke's Bay; and down this we paddled for some distance, but perceived no bones. Finding that we were willing to pay largely for specimens, a hundred persons set about hunting for them, and brought those they collected to Mr. Williams." Mr. Colenso states, that hitherto (in 1842) bones have only been found within the waters and channels of those rivers which discharge themselves into the southern ocean between the East Cape and the south head of Hawke's Bay, on the east coast of the North Island. They only occur on the banks of gravel, &c. in the shallowest parts of the rivers after floods occasioned by heavy rains, and when the waters have subsided to their usual level.

"These rivers are in several places at a considerable depth below the present surface of the soil, often possessing a great inclination, as is at once perceived by the rapidity of their currents. They have all a delta of greater or less extent at their mouths, from an inspection of which it is obvious that their channels have considerably

* Zool. Trans. vol. iii. p. 308, pl. 38.

† Ibid.

‡ Prof. Owen in Zool. Trans. vol. iii. p. 308.

§ See Annals of Nat. Hist. vol. xiv. New Series, p. 81.

changed. The rocks and strata in these localities indicate generally both secondary and tertiary formations; the former consisting of argillaceous schist, sandstone, conglomerates, greensands, &c.; the latter of clay, marly *calcareous tufa*, sand, gravel, and alluvial deposits." The true situation of the Moa bones is not known with certainty, but Mr. Colenso infers that they are found in the lowermost tertiary deposit. The localities mentioned by Mr. Colenso lie to the east of the volcanic chain of Tongariro, and the rivers probably have their origin on the flanks of that volcanic region.

The collection formed by Dr. Mackellar was from the Middle Island, from a superficial turbary formation on the coast, which was submerged at high tide, and is near the settlement at *Waikawaite*. Mr. Percy Earl, who obtained his specimens from the same locality, mentions that this deposit, which is overflowed by the sea at high tides, had been covered by a layer of sand and shingle; but this covering had been swept away by storm-waves a short time before his arrival, and a bed of black peat was exposed, from the surface of which bones projected; these and other specimens were procured by digging close to the surface, or at a moderate depth in the peat; they were all *Dinornis*' bones*.

The account given by the Rev. Mr. Taylor of Wanganui, a settlement on the western coast of the North Island, near the embouchure of the river of that name, lying to the south of Cape Egmont, as New Plymouth does to the north, is, in substance, as follows:—

In 1843 he procured a collection of bones during a journey to Turakina (?), from having observed a fragment of large bone, which induced him to inquire of the natives if such relics were to be met with. The Maories pointed out to him several little hillocks of bones, scattered here and there over the valley at the mouth of the river Whaingailhu (?) where the sand had drifted. Mr. Taylor describes these heaps as being composed of bones of several kinds of Moa, as though the flesh of the birds had been eaten, and the bones thrown indiscriminately together. The bones were in so friable a state that only the large ones would bear removal; the smaller ones pulverized in the hand, and below the surface the whole was a mass of decomposed bone. "The subsoil was a loamy marl, beneath which was a stratum of clay that chiefly forms the cliffs of this part of the western coast; it contains numerous marine shells, and closely resembles in appearance the *gault* of the south-east of England. I have no doubt it was when that loamy marl formed the surface-soil that the Moa lived; for although it is laid bare by the river-side, yet in other parts *it is wholly covered by several strata of marine and freshwater deposits*. I have found the bones of the Moa in this bed, not only in other parts of the western, but also in the eastern coast, at the East Cape, and at Poverty Bay. I have not heard of this deposit having been noticed north of Turakina (?) †."

All the specimens sent from the localities above-mentioned, with the exception of those from the South or Middle Island, are in the

* Zool. Trans. vol. iii.

† See Prof. Owen's Memoir on the *Dinornis*, Zool. Trans. vol. iii. p. 327.

state of the mammalian bones that occur in the ancient alluvial deposits of England. They are permeated and coloured more or less deeply by a solution of iron, and the cancelli are filled by the mud or silt in which they were found imbedded. They are but little water-worn, and have not suffered much abrasion; having, probably, been protected by the muscles and soft parts during their transport to the places where they were deposited. In short, their state of fossilization corroborates the accounts given of the nature of the alluvial bed from which they were procured; they strikingly resemble in this respect the bones of the Irish Elk, Mammoth, &c. of our diluvium.

But the bones collected by my son present a very different appearance from any previously received from New Zealand; instead of being of a dark colour, heavy, and permeated by silt and iron, they are, on the contrary, light and porous, and of a delicate fawn-colour; the most fragile processes being entire, and the articulating surfaces as smooth and uninjured as if prepared by the anatomist: *egg-shells*, *mandibles*, even the *bony rings of the air-tubes* are preserved. In their general aspect these bones most resemble those from Gaylenreth and other ossiferous caverns. The state of preservation of these specimens is evidently due to the material in which they were imbedded, which is a loose volcanic sand, containing magnetic iron, crystals of hornblende and augite, &c., the detritus of augitic rocks and earthy tuff. This sand has filled all the cavities and cancelli that have external openings, but is in no instance consolidated or aggregated together; it is easily removed from the bones by shaking, or by a soft brush. A very few water-worn pebbles of volcanic rocks were the only extraneous bodies found in the sand: there are no vestiges of shells of mollusca of any kind; but there is in the collection a small *Arca* imbedded in a sandy clay, and an ammonite coated with pyrites, so like a specimen of *A. biplex* from the Kimmeridge clay of England, as not to be distinguishable from a genuine British fossil.

The name of *Waingangoro*, the locality which my son mentions as that where he dug up the greater part of his collection, does not appear in the maps of New Zealand I have inspected; but from some incidental remarks in his letters, I have reason to infer that it is situated in the higher part of the valley of the Wanganui, a river which has its source in the volcanic regions of Mount Egmont. It was at the embouchure of the Wanganui that Mr. Taylor obtained the bones in his possession. It will be remembered that the streams which yielded the relics procured by Mr. Colenso and Mr. Williams, lie to the east of Tongariro, and probably originate in that elevated volcanic chain, many parts of which are above the line of perpetual snow. The specimens collected by my son were found imbedded in and filled with loose sand, at a considerable distance from the bed of the river; in no instance do they exhibit any traces of silt or fluvial mud. My son mentions having on one occasion obtained bones from a potato-pit sunk by a native remote from any stream*.

* Wonders of Geology, 6th edition, p. 129.

With the view of elucidating these remarks, and the inferences I shall presently venture to suggest, I will here concisely describe the geological structure of New Zealand, on the authority of Dr. Dieffenbach. This country, which is situated between 30 and 50 degrees of south latitude, forms a group of mountainous islands nearly as large as England and Wales. Its geological structure is with difficulty determined, owing to the primæval forests which fringe the coast; and where these have been destroyed, by impenetrable thickets of esculent fern. The fundamental rock is everywhere clay-slate, which is frequently traversed by greenstone dykes, as at Port Nicholson, Queen Charlotte's Sound, and Cloudy Bay. On the banks of the rivers Eritonga, Waibo, and along some parts of the sea-coast, *there are horizontal terraces of boulders of trap-rocks 50 feet high.* Anthracite coal crops out in the harbour of Wangarua; and there is a seam of the same mineral intercalated in the hard grey sandstone on the east coast of the Northern Island. On the west coast of the same, the limestone contains a few shells, as pecten, ostrea, terebratula, and an *Echinus spatangus*. The coasts are in many places fringed with recent horizontal sediments, consisting of loam with fragments of wood and fern, &c. The small rocky islands of trachyte off the coast of the Northern Island also *bear marks of wave-action to the height of 100 feet above the present sea-level.* In the interior of the Northern Island there is a lofty central group of volcanic mountains, some of the volcanos being still in activity: the ancient lava-streams appear to have been principally erupted from the base of the craters. The highest mountains are Tongariro, which is 6000 feet, and Mount Egmont, 9000 feet high. The loftiest summits are covered with perpetual snow. There are many lakes, which appear to occupy ancient craters*.

The occurrence of terraces of loam and gravel of comparatively recent date, at an elevation of from 50 to 100 feet above the sea, along the coasts of New Zealand, prove that a considerable change in the relative level of the land and water has taken place since those terraces were deposited, and at no very remote period. The present rivers of the country are described as now cutting deeply the beds of volcanic detritus and silt in which the birds' bones are contained; and the latter are in some places covered by marine and freshwater deposits. The facts adduced appear to me confirmative of the opinion advanced by Mr. Colenso (in 1842), that the true situation of the ossiferous deposit is beneath the surface-soil of the fluvial beds formed by the present rivers. In the more elevated regions the bone-deposit consists of pure volcanic sand and detritus; while in the low districts and along the coasts it is composed of fluvial mud or silt, which in many places is covered by modern beds of shingle and gravel.

II. *Description of Mr. Walter Mantell's Collection.*—I will now describe in general terms the most interesting specimens in the collection formed by my son; the anatomical details, and the important physiological inferences resulting therefrom, will be laid

* British Association Reports for 1845.

before the Zoological Society by Professor Owen; to whom, as a tribute of respect due for his masterly interpretation of the bones previously transmitted from New Zealand, I have offered the examination and description of every object in the series that he may consider worthy his attention.

The specimens amount to between seven and eight hundred, and belong to birds of various sizes and periods of growth; some evidently of aged individuals, and others of very young animals, in which the epiphyses of the long bones are still distinct from the shaft. They were catalogued by my son as follows:—

BIRDS' BONES.—*Crania and mandibles*, 19; *vertebræ*, 250; *sterni*, portions of, 7; *pelves*, more or less complete, 30; *femora*, 37; *tibiæ*, 42; *fibulæ*, 35; *tarso-metatarsal*, 40; *phalangeal*, 200; *ungueal* or *claw-bones*, 30; *ribs*, 30; *egg-shells*, fragments, 36 specimens.

SEALS.—*Jaws with teeth*, portions of *crania*, *vertebræ*, *ribs*, *scapulæ*, bones of the extremities.

TERRESTRIAL MAMMALIA.—One femur.

The specimens received exceeded the number above specified, and with the exception of a few of the most fragile (and unfortunately the most precious, as, for example, the mandibles, pelves, sterni), arrived in an excellent state of preservation.

The birds' bones, so far as they have been hitherto examined by Professor Owen, are referable to five genera; the crania and mandibles of three of which were previously unknown.

1. *Dinornis*.—This name is now restricted by Professor Owen to the birds which possessed a skull and beaks essentially different from any form either recent or fossil. Of this genus there is a nearly perfect cranium, with the upper mandible, and portions of two other skulls. The form of the cranium, especially of the temporal and occipital regions, is wholly unlike any hitherto observed in the class of birds, and approaches that of reptiles. It is characterized by the nearly vertical occipital plane, the elevated position and form of the foramen magnum, and the great development below the occipital condyle, and the strong ridges which border the basi-occipital, and indicate a most extraordinary power in the muscles that moved the cranium. The temporal fossæ are very deep, and are strengthened by a prolongation of the mastoid process, which is united to the frontal, and forms what may be termed a lateral zygomatic arch. The tympanic bone has two distinct cusps for articulation with the double condyle of the os quadratum. The configuration of the upper mandible or beak (the lower one is unknown) is very peculiar, and has been aptly compared by Professor Owen to a cooper's adze; and is considered by him to have been especially adapted for grubbing up roots and tubers; and we have evidence, in the powerful muscles attached to the occipital region, of its having been an instrument capable of being used with great force. There is a portion of the articular part of a large lower jaw, that probably belongs to *D. giganteus*.

To this genus belong many vertebræ of enormous size; ribs, bones of the pelvis, and hinder extremities, and some portions of sterni;

they are referable to six or seven species, respectively named from their size and osteological character, *D. giganteus*, *D. robustus*, *D. ingens*, *D. casuarinus*, *D. geranoides*, *D. curtus*, *D. didiformis*.

Among the bones of the extremities of the large species, I would especially direct attention to the femur, tibia and fibula of a young bird. The femur is 14 inches long, 9 inches in circumference round the shaft, and 16 inches round the condyles. The tibia, in which the union of the epiphysis of the proximal extremity is still incomplete, is 30 inches long, 6 inches in circumference at the shaft, and 14 at the condyles. The tibia of a much younger bird gives still more colossal proportions; for it measures 12 inches in circumference at the condyles, and yet the distal epiphysis, which is always rapidly ankylosed to the shaft in birds, is still distinct. The proximal extremities of other tibiæ are 17 inches in circumference; and there are fragments of shafts 8 inches round.

2. *Palapteryx*.—In this genus the skull differs essentially from that of the *Dinornis*; the occipital region is narrower; the foramen magnum is situated in the centre, which in the *Dinornis* is occupied by the condyle; the basi-occipital is not so much developed; and there are other osteological peculiarities which I need not detail. The rostral part of both mandibles is preserved, and shows an approach to the *Dromaius* or *Emeu*. The ethmoid cavities, or upper nostrils of the skull, are very large, as in the *Apteryx*, a peculiarity denoting a remarkable development of the organs of smell.

Of this genus there are imperfect crania, mandibles, vertebræ, bones of the extremities, &c.

3. *Aptornis*.—Among the bones of small size, those for example that are comparable in magnitude to the skeletons of the Bustard and *Apteryx*, there are several tarso-metatarsals, femora, tibiæ, pelves, &c., which indicate a new tetradactyle genus, very closely allied to the living struthious bird of New Zealand, the *Apteryx*. Some of these bones are referable to the *D. otidiformis*, or Bustard-like Moa, of Professor Owen's second memoir: I believe the name of *Aptornis* will be assigned to this genus.

The other birds' bones belong to genera and species of which there are still living forms in New Zealand and Australia.

4. *Notornis*.—This genus is established by Professor Owen from the skulls, and upper and lower mandibles, vertebræ and bones of the extremities, of birds belonging to the *Rallidæ* or Rails; and closely allied to the living *Brachypteryx*, a species of Coot or Waterhen peculiar to New Zealand. The mandibles are sharp like those of the Raven, but are more compressed laterally; the cranium presents some interesting anatomical characters. The original was of the size of a bustard.

5. *Nestor*.—The collection contains two upper mandibles of a species of *Nestor*, a genus of nocturnal owl-like parrots, of which only two living species are known. One of these (*Nestor hypopolius* of Mr. Gould) is restricted to New Zealand; and the other (*N. productus*) to Philip Island, which is not more than five miles in extent; and Mr. Gould remarks that "so exclusively is the *Nestor productus*

confined to this isolated spot, that many persons who have resided in Norfolk Island for years have assured me that its occurrence there is unknown, although the distance from one island to the other is not more than three or four miles*."

Such is a brief account of the birds' bones that have been accurately examined by Professor Owen; but it is probable, when the vertebræ and other specimens that have as yet been only cursorily inspected are carefully compared with recent skeletons, other species and genera will be detected. Some of the vertebræ appear to belong to the existing species of *Apteryx*, *A. Australis*.

Egg-shells.—The fragments of egg-shells imbedded in the ossiferous deposits had escaped the notice of all previous observers, which is not surprising, for they are of small size and of very rare occurrence. My son, in all his wanderings, only procured between thirty and forty pieces. As these precious relics will shortly be described by Professor Owen, I will only mention that the edges of most of them are rounded, as if water-worn. They belong to different species, or perhaps genera: some of them are smooth, but others have the external surface marked with short interrupted linear grooves, resembling the eggs of some of the Struthionidæ, but still presenting very characteristic peculiarities.

No vestiges of the bones of the wings have been detected.

SEALS.—The remaining part of the collection consists of jaws with teeth, scapulæ, vertebræ, ribs, femora, and other bones, of a species of large seal; whether distinct from the two kinds (*Phoca leptonyx* and *P. leonina*) that inhabit the southern seas, and occasionally visit the shores of New Zealand, I have not yet been able to determine. The bones were found mixed indiscriminately with those of the birds, and are filled with volcanic sand.

Femur of a Carnivore.—One other relic must be specified, *the femur of a dog*; the sole fossil bone of a terrestrial quadruped that has hitherto been discovered in the ossiferous deposits of New Zealand.

Burnt Moa, and Human bones.—I must not omit to mention a very remarkable incident. In one spot the natives pointed out to my son some little mounds covered with herbage, as containing bones, the refuse of feasts made by their ancestors; and upon digging into these hillocks they were found to be made up of burnt bones. These consisted of *Moas'*, *Dogs'* and *human bones* promiscuously intermingled. These bones, which have evidently been subjected to the action of fire, contain no traces whatever either of the earthy powder or ferruginous impregnation so constant in the fossil bones from the fluvial silt, nor of the volcanic sand with which all the bones collected by my son are more or less permeated. Mr. Taylor (*ante* p. 229) mentions having found similar heaps of bones in the valley of the Whaingailu, "*as though the flesh of the birds had been eaten, and the bones thrown indiscriminately together.*" If such was the origin of these heaps of bones, and they are to be regarded as the rejectamenta of the feasts of the aborigines, the practice of cannibalism by

* Mr. Gould's Birds of Australia.

the New Zealanders will appear to have been of very ancient date, and not to have originated from the want of animal food on account of the extinction of the Moas, as Professor Owen so ingeniously and indulgently suggested in extenuation of this horrid practice by so intelligent a race as the Maoris.

III. *General Conclusions.*—From the scattered facts which I have thus brought together in order to throw some light on a question of such deep palæontological interest—upon the principle that the feeblest rays, when concentrated into a focus, will produce some degree of illumination—I think we may safely infer that the islands of New Zealand were densely peopled at a period geologically recent, by tribes of gigantic ostrich-like birds, of species and genera which have long since been obliterated from the face of the earth; and that subsequently to this “*Age of Struthionidæ*,” the land has undergone those physical changes, by which the areas occupied by the ornithic ossiferous deposits, and the beds of shingle and loam, which now form terraces from 50 to 100 feet above the sea-level, were elevated to their present positions. This inference seems to be corroborated by the fact that the existing mountain-torrents and rivers flow in deep channels which they have eroded in these pleistocene deposits; in like manner as the rivers of Auvergne have excavated their course through the mammiferous tertiary strata of that country.

The accounts given by Mr. Colenso, the Rev. H. Taylor and others, of the exposure of the bone-bed in the channels of the mountain-streams, and of the bones being left on the river-shoals after heavy floods, remind us of the conditions under which the mammalian fossils of the Sub-Himalayas were first brought under the notice of our eminent countrymen, Major Cautley and Dr. Falconer. And in New Zealand, as in India, the fossil remains of extinct animals are associated with those of existing genera; and the land is still inhabited by diminutive representative forms of the colossal beings which flourished in the pleistocene, or early human epoch; for the *Apteryx* and the *Porphurio* may be regarded as the living types of the *Moa* and the *Notornis*.

I do not deem it necessary to enlarge on the question whether the *Dinornis* and *Palapteryx* still exist in New Zealand; on this point I would only remark, that Mr. Colenso, who was the *first* observer that investigated the nature of the fossil remains with due care and the requisite scientific knowledge, (having determined the struthious affinities of the birds to which the bones belonged, and pointed out their remarkable characters, ere any intelligence could have reached him of the result of Professor Owen’s examination of the specimens transmitted to this country,) has given, in his masterly paper before quoted, very cogent reasons for the belief that none of the true Moas exist, though it is probable the last of the race were exterminated by the early inhabitants of these islands.

But whatever may be the result of future researches as to the relative age of the ossiferous deposits, or the existence or extinction of the colossal bipeds whose relics are before us, this fact cannot be questioned—the vast preponderance of the class of birds which pre-

veiled (and still prevails) in the fauna of New Zealand, to the almost entire exclusion of mammalia and reptiles. Any palæontologist who saw the entire collection formed by my son alone could not but feel surprise at its extent and variety. I may venture to affirm that such an assemblage of the fossil bones of birds was never before seen in Europe—nearly one thousand specimens collected from various parts of the country, with scarcely any intermixture of those of any other class: it is a phænomenon as marvellous as the exclusively reptilian character of the fauna of the Wealden epoch. In fact, New Zealand at the present time, as Dr. Dieffenbach observes, offers the most striking instance of an acknowledged fact in every branch of natural history, namely, that different areas of dry land are endowed with peculiar forms of animal and vegetable life; centres or foci of creation, so to speak, of certain organic types. And this organic law, with the effects of which, in the palæozoic and secondary ages, our geological researches have made us familiar, appears to have continued in unabated energy to the present moment. In fact, the most remarkable apparent anomalies in the terrestrial faunas and floras of the secondary epochs are not without modern parallels.

Thus New Zealand, with its peculiar flora, characterized by the predominance of ferns, club-mosses, &c., to the almost entire exclusion of the graminaceæ,—and its fauna, comprising but two or three mammals and reptiles,—and the enormous development of the class of birds,—presents a general correspondence with the lands of the carboniferous and triassic epochs.

Australia and Van Diemen's Land possess a flora equally peculiar and extraordinary, and a fauna unlike that of any other part of the world, including some of the most anomalous of existing forms, as for example that marvellous creature the Ornithorhynchus. These countries, in the abundance and variety of the Cycadeaceæ, Araucariæ, &c.—in the marsupial character of the great proportion of the mammalia—and in the Terebratulæ and Trigonixæ, and the Cestra-cion fishes which swarm in the seas that wash their shores, approximate in their organic relations more nearly to those ancient lands of which the Stonesfield oolites are the debris, than to any of the present regions of the earth.

Lastly, we have a reflected image, as it were, of the "*Age of Reptiles*" of the secondary formations, in the exclusively reptilian character of the quadrupeds of the Galapagos Islands, one species of mouse being the only indigenous mammalian. This Archipelago is a group of volcanic islands situated under the equator, between five and six hundred miles westward of the American coast. "It is," observes Mr. Darwin in his delightful Journal, "a little world within itself; most of the organic productions are aboriginal creations found nowhere else. Seeing every height crowned with its crater, and the boundaries of most of the lava-streams still distinct, we are led to believe that within a period geologically recent, the unbroken ocean was here spread out." These islands swarm with herbivorous marine and terrestrial reptiles allied to the Iguanidæ, which are known in no other part of the world; and they are as completely distinct from

all other existing reptiles, as are the extinct *Iguanodon* and *Hylæosaurus*. The flora too contains more than a hundred plants unknown elsewhere. There is not a fauna or flora in any of the ancient geological periods that presents greater anomalies. Mr. Darwin emphatically remarks, that "when we consider the well-beaten paths made by the thousands of huge tortoises with which these islands are traversed,—the many turtles,—the great warrens of the terrestrial *Amblyrhynchi*, and the groups of marine species basking on the coast-rocks of every island of this Archipelago,—we must admit that there is no other quarter of the world where the Order of Reptiles replaces the herbivorous mammalia in so extraordinary a manner. The geologist on hearing this will probably refer back his mind to those Secondary Epochs, when saurians, some herbivorous, some carnivorous, and of colossal dimensions, swarmed on the lands and in the seas. It is therefore worthy his especial observation that this Archipelago, instead of possessing a humid climate and a rank vegetation, must be considered as extremely arid, and for an equatorial climate remarkably temperate*."

I have endeavoured to express in the annexed table the organic relations between the countries above-mentioned and their geological analogues.

MODERN EPOCH.

New Zealand.

Predominance of Ferns, Lycopodiaceæ and other Cryptogamia. Gigantic Birds. Mammalia absent.

Australia.

Cycadeaceous Plants. Marsupial Mammalia.

The Galapagos Islands.

Predominance of Reptiles. Herbivorous, terrestrial and marine Saurians and Chelonians.

SECONDARY EPOCHS.

Countries of the Carboniferous and Triassic periods as indicated by fossil remains.

The lands whence the Stonesfield and Carboniferous oolitic strata were derived.

The country of the *Iguanodon*, and the regions that supplied the detritus that formed the fluvio-marine secondary strata.

In this point of view the "*Age of Reptiles*" may be considered as merely disclosing an exaggerated effect of the organic law of creation, which imparted to the fauna of the Galapagos Islands its reptilian character. In Australia, and in the Oolitic lands, the mammalian fauna assumed the marsupial type. In New Zealand, and in the Triassic countries, the ornithic vertebrata predominated.

If the ancient philosophers, ere the discoveries of Columbus had opened the New World to the European mind, had found in a fossil state such collocations of the remains of animals and plants as are presented by New Zealand, Australia, and the Galapagos Islands, how impossible would it have been for them, by any comparison with existing nature within their circumscribed geographical boundary, to have conceived the possibility of such assemblages of animated beings existing contemporaneously with themselves! In fact, the present geographical distribution of peculiar types of terrestrial animals and plants, affords as many anomalies in the relative predominance of different classes and orders, as are to be found in the vestiges of the earlier ages of our planet.

* 'Journal of a Voyage round the World,' chap. xvii.

From these considerations I think we must conclude, that throughout all geological time the changes on the earth's surface, and the appearance and extinction of peculiar types of animals and plants, have been governed by the same physical and organic laws; and that the paroxysmal terrestrial disturbances, though apparently in the earlier ages involving larger areas, and operating with greater energy than the volcanic and subterranean action of modern times, did not affect the established order of organic life upon the surface of the globe; and that throughout the innumerable ages indicated by the sedimentary formations, there was at no period a greater anomaly in the assemblages of certain types of the animal and vegetable kingdoms than exists at the present time.

Additional Remarks on the Geological Position of the Deposits in NEW ZEALAND which contain Bones of Birds. By GIDEON ALGERNON MANTELL, Esq., LL.D., F.R.S. &c.

SINCE I had the honour of communicating to the Geological Society a notice of the collection of fossil bones of birds from New Zealand, I have received a letter from Mr. Walter Mantell, dated Wellington, June 18, 1847, containing some details respecting the bone-deposits and the strata with which they are associated, which are of considerable interest, and confirm in every essential particular the conclusions suggested in my former communication. The following are extracts from my son's letter:—"The principal part of the best specimens I have transmitted to you I obtained from near the embouchure of a stream called Waingongoro, which lies about a mile and a half south of Waimate in the Ngátirúanú district. The country hereabout is an elevated table-land, with deep tortuous gullies, through which the torrents and streams take their course to the sea. That of Waingongoro, which is as tortuous as any of them,

Ground plan of the embouchure of the River Waingongoro.



Fig. 1.

a, a, a. Indicate excavations made in the tract of drifted sand containing the birds' bones.

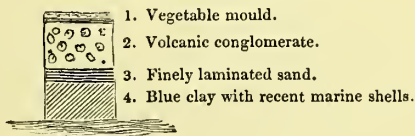
b. The Pa Ohawetokotoko.

••• The Pa or village of Tukikahi.

appears to rise in Mount Egmont (the volcanic ridge which is 9000 feet high); indeed it must have its source there, or in the short chain of hills which lies between that mountain and the coast in a westerly direction; for in returning to New Plymouth by the mountain road—a forest-track at the back of the volcanic ridge—I must have crossed it, did it rise elsewhere. The Waingongoro evidently discharged itself at some distant period into the sea, far from its present embouchure, as is proved by the existence of a line of cliffs which extends inland, and has clearly been produced by the eroding action of the river. Driven from its course, probably by a change in

Fig. 2.

Vertical Section of the Cliff.



the relative level of the land and sea, it has formed its present channel, which cuts through a hundred feet of loose conglomerate, overlying a bed of finely laminated sand, and containing wood in a very recent state,—so recent as to bear cutting with a knife.

“The conglomerate is composed of an infinite variety of volcanic rocks, with numerous immense rounded masses of the same kind. The following sketch will give you a general idea of the structure of the coast from Wanganui to Taranaki; but the distances are of course merely approximative and very incorrect, and so also is probably the

Fig. 3.

Section of the Coast from Waimati to Wanganui.

Mount Egmont,
in the remote distance.

Wanganui.



2. Volcanic conglomerate.

3. Sand with birds' bones and egg-shells.

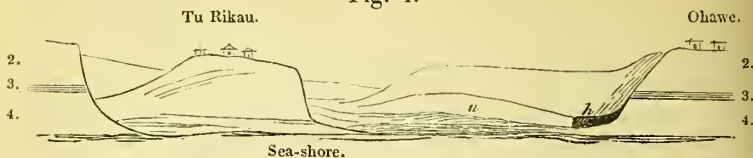
4. Blue clay with recent marine shells.

highest point of the clay, but I know you will understand my meaning better by this rough diagram than by mere description. The clay abounds in marine shells, all of existing species (?); the upper layers contain but few shells, but the lowermost abound in them, and they are in a perfect state—not drifted shells. In a stratum of sand at Wanganui the shells of a sandy-bottomed sea are found, with some fragments of large Nautili.

“Between Takikau and Ohawetokotoko there is a wide flat of undulating sand, about two hundred yards across (Fig. 1, *a, a, a*). On my first visit the surface was covered with bones of men, moas and seals, &c., which had been overhauled by the Rev. R. Taylor. I had

some deep openings made near the base of the ancient cliffs, under the Pa Ohawe (at *a, a, a*, &c.; see also No. 3); and at the same level as

Fig. 4.



2. Volcanic conglomerate.
3. Finely laminated sand.
4. Blue clay, with recent marine shells.
- a.* Bone-bed exposed at the foot of the cliffs, on which is the Pa Ohawe.
- h.* Part dug away.

that on which were the strewn fragments of bones I have mentioned, I came to the regular bone-deposit. The bones were mostly perfect in shape, but so soft, that if grasped strongly they would change, as if by magic, into clay. Unfortunately the natives soon caught sight of my operations, and came down in shoals, trampling on the bones I had carefully extracted and lain out to dry. My patience was tried to the utmost, and to avoid blows I was obliged to retreat and leave them in full possession of the field; and to digging they went in right earnest, and quickly made sad havoc. No sooner was a bone perceived than a dozen pounced upon it, and began scratching away the sand as if for their lives; and the bone was of course smashed to pieces. I am only surprised that I ultimately succeeded in getting any entire.

“The natives affirm that this sand-flat to Rangatapu was one of the places first dwelt upon by their ancestors; and this seems not unlikely, for in digging in various places I found small circular beds of ashes and charcoal and bones, very ancient, and such as are generally left by the native fires that have been long lighted in the same spot. Fragments of obsidian, native flint, two fishing-line stones and a whalebone *meri* (a sort of weapon) were also dug up. The natives told me, and their assertion was borne out by the appearance of the place, that within their memory the entire area had been covered by drift-sand; in fact, the bones seemed always to be imbedded on or beneath an old surface-level. Columns of vertebræ when uncovered were lying *in situ* and perfect, with, in rare instances, skull and pelvis; but to preserve these precious relics was impossible while beset with the hordes of Maoris; and I could not drive or bribe them away.

“The largest femur, tibia and fibula were lying in their natural connection—the leg slightly bent at the knee; a chain of vertebræ of the largest size was discovered near them, and I doubt not the whole belonged to the same colossal bird. You will readily imagine how exasperating it was to me to see specimen after specimen destroyed before my eyes, with no possibility of preventing it. From your ignorance of the excessive obstinacy and mulishness of the natives, I fear your indignation will be directed against me; but if so, let me assure you, you are indeed in error. All that man could do I did to dissuade them from turning oryctologists or palæornithists; but to

no purpose. Men, women and children resolutely dashed at every bone that appeared when the sand was removed; and if they listened for a moment to my entreaties and remonstrances, it was but to return with renewed vigour to the work of destruction. Although I am of a forgiving disposition, yet I cannot but hope Mr. Hawkins will place these Maoris in the same category with the Vandals who destroyed the Alexandrian library, and the Somersetshire 'varmint' who mistook a *Chciroligostinus* for a 'viery zarp'nt.'

"Mixed with the bones, but exceedingly rare, were the fragments of egg-shells, of which I sent you my then best specimens by post last April. I have also found six oval rings and one broad circular ring of the trachea. In coming down from Ngamotu I discovered a few more remains of eggs; one fragment is four inches long, and gives a good chord by which to estimate the size of the original: as a rough guess, I may say that a common hat would have served as an egg-cup for it: what a loss for the breakfast-table! And if native traditions are worthy of credit, the ladies have cause to mourn the extinction (?) of the *Dinornis*: the long feathers of its crest were by their remote ancestors prized above all other ornaments; those of the White Crane, which now bear the highest value, were mere pigeons' feathers in comparison."

I have given these extracts without correction or comment, as they were written by my son for my private information, that I might not weaken the graphic description of the exhumation of the bones exhibited and described at the last meeting of the Society. There are still some details required to render it certain that the bone-bed is always intercalated, when not laid bare by modern denuding causes, between the blue clay with recent marine shells and the conglomerate of volcanic pebbles and boulders which forms a bed of from fifty to a hundred feet thick; but so far as I can interpret my son's meaning, and upon comparison of his statements with those of Mr. Colenso and others, I conclude that such is its true geological position. There is also some doubt whether in the heaps of ancient native fires which contain bones of man, dog, and moa, those of the colossal birds may not have been introduced by accident, and their charred appearance have been occasioned by drying, from exposure to the air and sun; but it must be remarked that these specimens never contain any of the sand in which they were imbedded, as the other examples do. These and other points will, I doubt not, be satisfactorily elucidated ere long, now that the collecting of the bones of the extinct birds of New Zealand is so earnestly and systematically pursued. In the meanwhile, the imperfect and hasty sketches of my son which I have placed before the Society, will not, I trust, be deemed altogether unworthy attention.

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